



7 Phosphorus TMDLs for the Northwest Water Region

Black Creek, Wawayanda Creek, Lockatong
Creek, and Wickecheoke Creek Watersheds

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**New Jersey Department of Environmental Protection
Division of Watershed Management
Bureau of Environmental Analysis and Restoration**

Todd W. Kratzer, P.E.





Overview of Presentation

- What is a TMDL
 - Flow Integrated Reduction Methodology
 - TMDL Calculations for Impaired Segments
 - TMDL Implementation Measures
 - Summary
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What are TMDLs?

- Total Maximum Daily Loads (TMDLs) represent the assimilative or load capacity of the receiving water, taking into consideration:
 - point sources of pollutants
 - nonpoint sources of pollutants
 - natural background
 - surface water withdrawals

2004 Integrated List

305(b)
Report

SUBLIST 1 & 2: FULL ATTAINMENT

LIMITED ATTAINMENT DATA

SUBLIST 3: INSUFFICIENT DATA TO ASSESS

SUBLIST 4: IMPAIRED BUT:

TMDL Completed

IMPAIRMENT BY POLLUTION NOT POLLUTANT

OTHER ENFORCEABLE MEASURES WILL ADDRESS

SUBLIST 5: NON-ATTAINMENT

} 303(d) List

Establish & Implement TMDLs

- Establish TMDL in accordance with MOA schedule with EPA:
 - Propose TMDL as an amendment to water quality management plans (WQMPs)
 - Establish TMDL - submit to EPA for formal approval
 - Adopt TMDL as amendment to WQMP
- Implementation of Control Actions:
 - Issue water quality-based permits
 - Additional Measures per Phase 2 Stormwater Permits
 - Implement nonpoint source controls through funding from NJDEP as it is available (319H & Corporate Business Tax)

How are TMDLs expressed?

Amount of pollutants that a waterbody can assimilate without violating surface water quality standards or other targets:

$$\text{TMDL} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

Where:

WLA is the wasteload allocation (Point Sources)
LA is the load allocation (Non-Point Sources) and
MOS is the margin of safety

Margin of Safety (MOS)

- A required component of the TMDL that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality (40 CFR 130.79(c))
- The MOS shall be expressed either as an internal modeling factor and/or as an explicit, separate factor (N.J.A.C. 7:15- 7.7(a))

Components of TMDL Document

- Source assessment
 - characterization and quantification as necessary
 - identify point, nonpoint and background sources
- Water quality analysis
 - link pollutant sources & water quality: model
 - consider seasonal variation / critical conditions
- TMDL calculations
 - loading capacity
 - margin of safety
 - load and wasteload allocations
- Follow-up monitoring
- Implementation
- Public participation

Target for TMDL: SWQS for Phosphorus (mg/L)

Numerical Criteria

- i. **Lakes:** TP not to exceed **0.05** in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where site-specific criteria are developed (N.J.A.C. 7:9B-1.5(g)3)
- ii. **Streams:** TP not to exceed **0.1** in any stream, unless it can be demonstrated that TP is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

SWQS for Phosphorus (mg/L), Continued

Narrative Criteria--Nutrient policies are as follows:

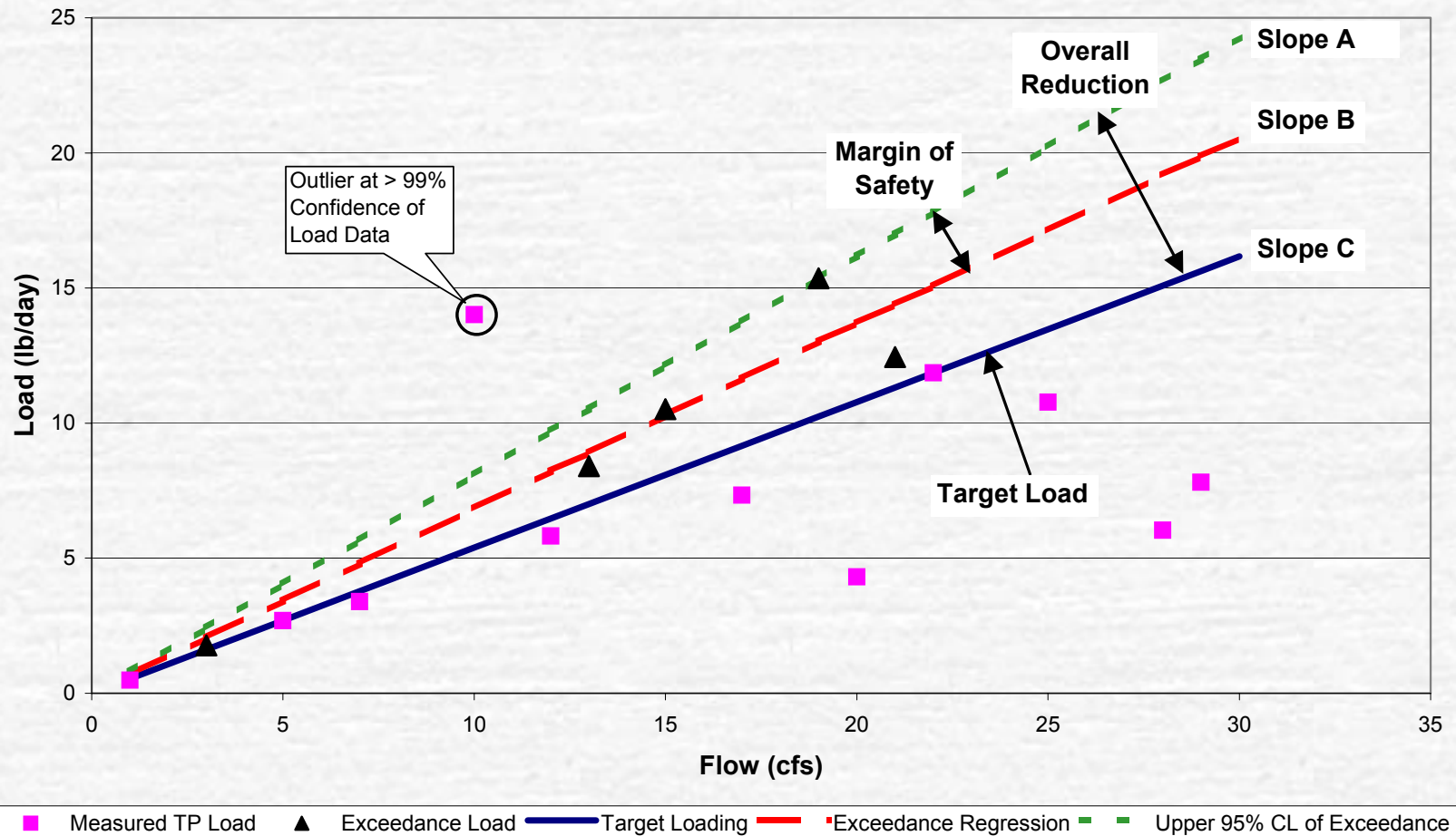
- Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

TMDL Model Used: Flow-Integrated Reduction of Exceedances (FIRE)

- Method must be selected to relate water quality to pollutant loading
- FIRE uses site-specific water quality concentration and flow data to determine the relationship between flow and load. The required reduction is calculated by comparing the site-specific relationship to the target relationship, which corresponds to attainment of the New Jersey Surface Water Standards.

Illustrative Example of FIRE

**Flow-Integrated Water Quality Exceedance Assessment
(Hypothetical Total Phosphorus Data)**



Load Capacity

- The Load Capacity of the waterbody is represented by the Target Loading line, including a Margin Of Safety (MOS)
- MOS is represented by the difference between the slopes of the Upper 95 percent confidence limit of the Exceedance Regression and the Exceedance Regression line and becomes an unallocated portion of the Load Capacity

Load Reduction

- The Overall Loading Reduction required is the summation of the required load reduction to attain standards and the MOS and is represented by the difference between the slopes of the Upper 95 percent confidence limit of the Exceedance Regression and the Target Loading lines

Allocating Load Reduction

- Existing load is calculated by applying loading (or export) coefficients, which represent annual average loads from various land uses, to the areal extent of each land use in the drainage area, determined using GIS
- WLAs and LAs are then derived from the allocable load, with LA reductions taken only from land uses where reductions are feasible
- No reduction is taken from forest, wetland, water and barren land uses; these load contributions remain unchanged between existing and future scenarios

Unit Areal Loads (UAL) Methodology

Pollutant Export Coefficients obtained from literature sources are applied to land use patterns:

- Land Use determined by NJDEP's 1995/97 GIS Coverage.
- Phosphorus export coefficients selected for NJ from an extensive database to develop table on next slide.

Phosphorus Export Coefficients (Unit Areal Loads)

land use / land cover	LU/LC codes	UAL (kg TP/ha/yr)
Mixed Density Residential	1100	1.2
medium / high density residential	1110, 1120, 1150	1.6
low density / rural residential	1130, 1140	0.7
Commercial	1200	2.0
Industrial	1300, 1500	1.7
mixed urban / other urban	other urban codes	1.0
Agricultural	2000	1.5
forest, wetland, water	1750, 1850, 2140, 2150, 4000, 5000, 6000, 7430, 8000	0.1
barren land	7000	0.5
Units 1 hectare (ha) = 2.47 acres : 1 kilogram (kg) = 2.2 pounds (lbs) 1 kg/ha/yr = 0.89 lbs/acre/yr		

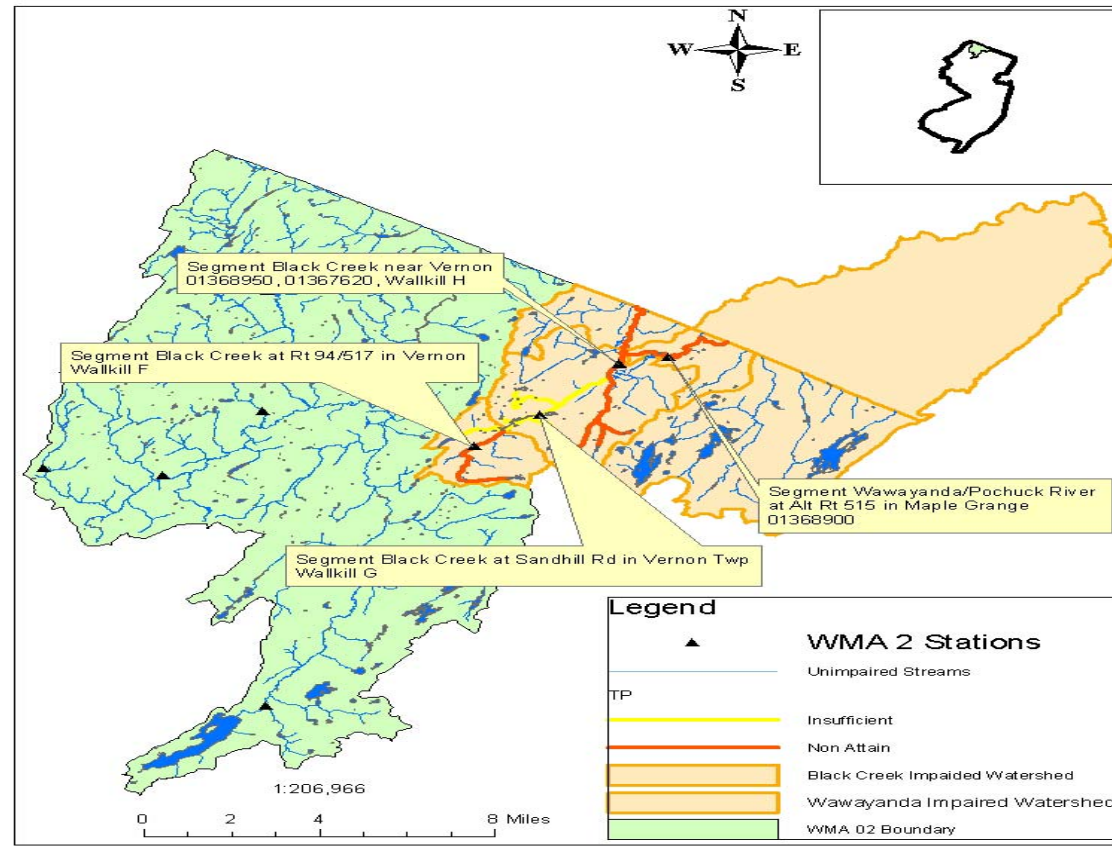
Impaired Segments (WMA 2)

TMDL Number	WMA	Station Name/Waterbody	Site ID	Sublist
1	02	Black Creek near Vernon	01368950, 01367620, Wallkill H	5
2	02	Black Creek at Rt. 94 and Rt. 517 in Vernon	Wallkill F	5
3	02	Wawayanda/Pochuck River at Alt Rt. 515 in Maple Grange	01368900	5
4	02	Black Creek at Sand Hill Road in Vernon	Wallkill G	3

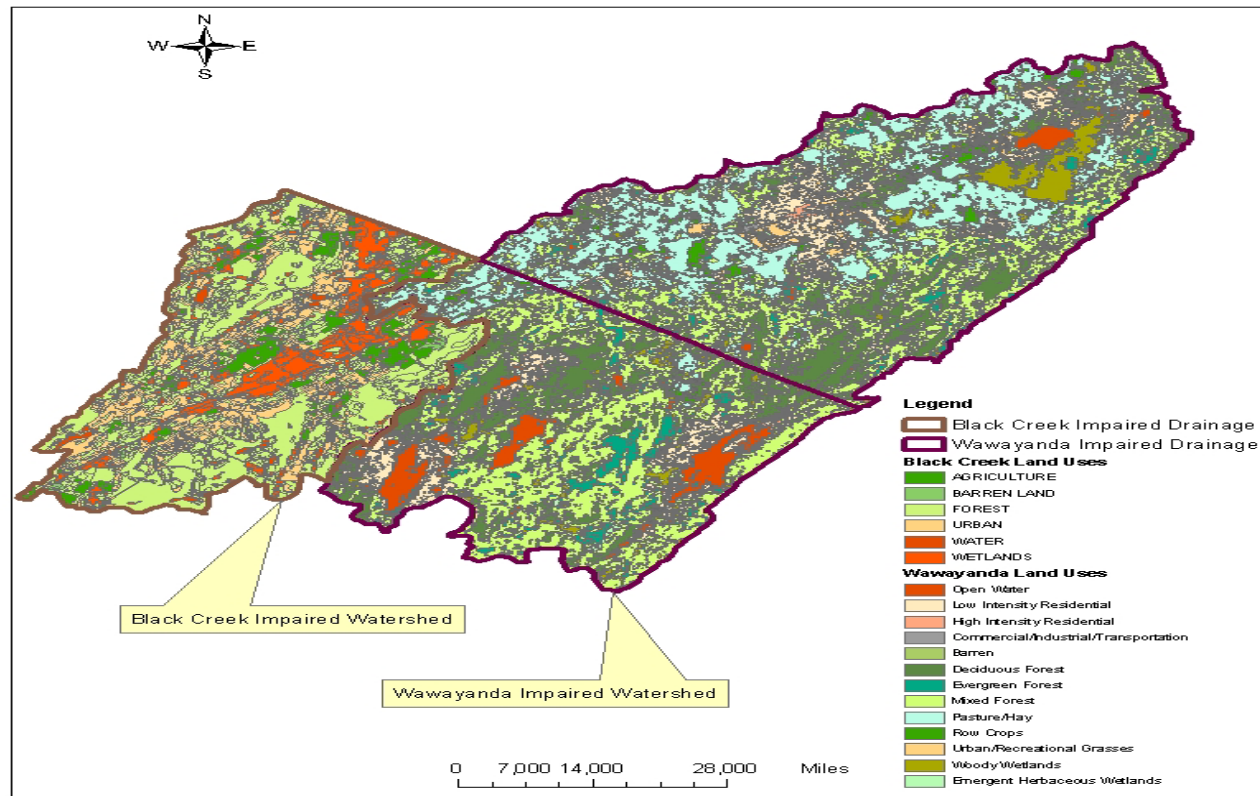
Summary of TMDL Data

- Phosphorus concentration: >10% results exceeded SWQS of 0.1 mg/L TP
 - Black Creek near Vernon; 6 of 50 results (12%)
 - Black Creek at Rt 94 and Rt 517 in Vernon; 5 of 15 results (33%)
 - Wawayanda/Pochuck River at alt. Rt. 515 in Maple Grange; 4 of 8 results (50%)
- Phosphorus could not be excluded as a limiting nutrient
- TMDL is Required
 - Black Creek at Sand Hill Road in Vernon; 1 of 14 results (7%) – Sublist 3

Spatial extent of impaired segments and affected drainage areas in WMA 2



Land Uses in the Black Creek and Wawayanda Watersheds



Application of FIRE (Example)

Data from Black Creek near Vernon

Derived from Export Coefficients:

Existing Loading = 2,856 kg/yr

Non-Adjustable Land-Use and Permitted Loads = 547 kg/yr

Derived from FIRE:

Slope A = 0.8948 (Upper 95% Confidence Limit of Exceedance Regression)

Slope B = 0.8576 (Exceedance Regression)

Slope C = 0.5390 (Target Loading)

Application of Results from FIRE:

Total Overall Loading Reduction = 1,061 kg/yr (37.1% of Existing Loading)

Target Load = TMDL = 1,795 kg/yr

Margin Of Safety (MOS) = percentage (4.2%) of Target Load = 74.5 kg/yr

TMDL calculations for the Black Creek Watershed (Black Creek at Vernon)

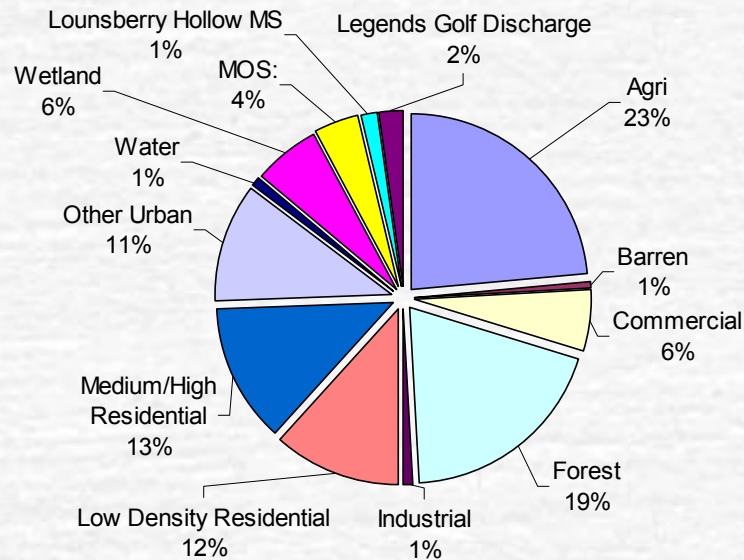
Existing Load = 2,856 kg/yr	Black Creek		% reduction
	kg TP/yr	% of LC	
Loading capacity (LC)	1795	100	n/a
Load allocation			
Point Sources other than Stormwater			
Lounsberry Hollow MS	22.09	1.2	0%
Legends Golf Discharge	42.18	2.3	0%
Nonpoint and Stormwater Sources			
medium / high density residential	229.4	12.8	50%
low density / rural residential	209.4	11.7	50%
commercial	99.59	5.5	50%
industrial	13.38	0.7	50%
mixed urban / other urban	196.3	10.9	50%
agricultural	424.9	23.7	50%
forest, wetland, water	472.0	26.3	0%
barren land	11.05	0.6	0%
Margin of Safety	74.49	4.2	n/a

Phosphorus allocation for the Black Creek impaired Watershed

Black Creek

Station 01368950, 01367620, Wallkill H, Wallkill F, Wallkill G

Load Capacity = 1795 kg/yr



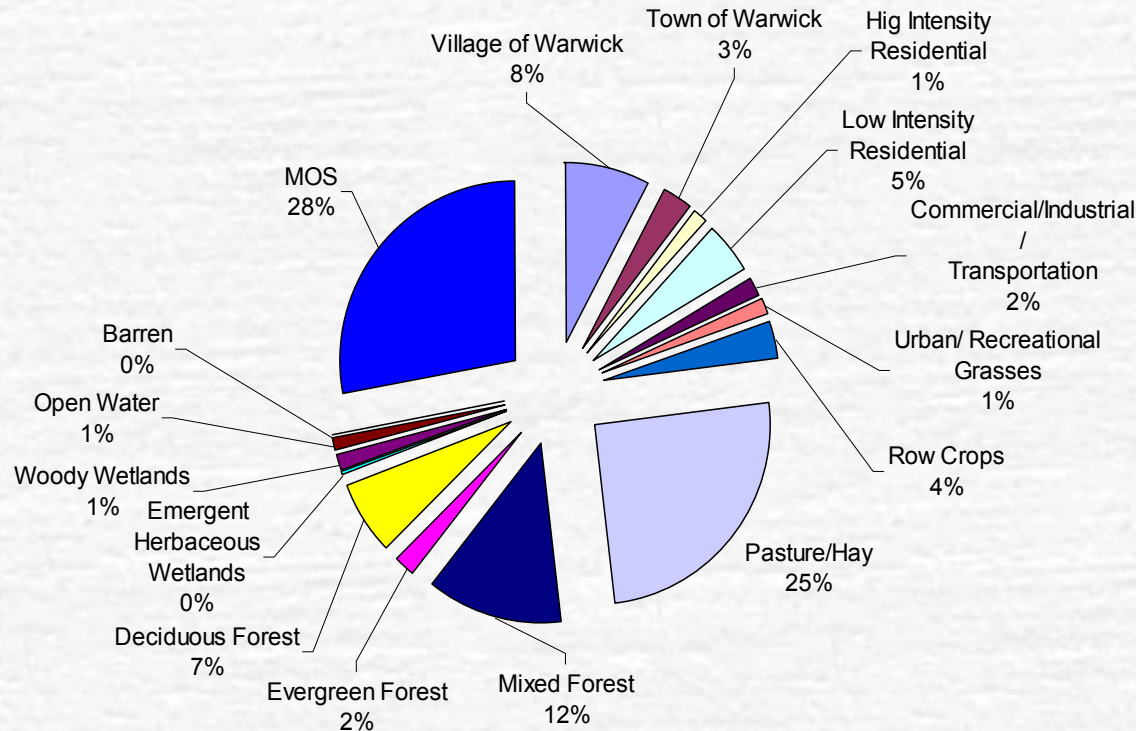
TMDL calculations for the Wawayanda/Pochuck Creek Watershed

Existing Load = 13,545 kg TP/yr	Wawayanda/Pochuck Creek		% reduction
	kg TP/yr	% of LC	
Loading capacity (LC)	5170	100	n/a
Load allocation			
Point Sources other than Stormwater	(from New York portion of watershed)		
Village of Warwick		7.8%	73%
	403		
Town of Warwick	145	2.8%	73%
Nonpoint and Stormwater Sources			
high intensity residential	70.78	1.4%	73%
low intensity residential	242.0	4.7%	73%
commercial/industrial/transportation	82.51	1.6%	73%
urban/recreational grasses	70.47	1.4%	73%
row crops	184.7	3.6%	73%
pasture/hay	1287.0	24.9%	73%
mixed forest	643.0	12.4%	0%
evergreen forest	104.8	2.0%	0%
deciduous forest	349.7	6.8%	0%
emergent herbaceous wetlands	7.198	0.1%	0%
woody wetlands	71.68	1.4%	0%
open water	61.01	1.2%	0%
Barren	0.630	0.01%	0%
Margin of Safety	1442	28%	n/a

Phosphorus allocation for the Wawayanda Creek impaired Watershed

Load Capacity = 5170 kg/yr

Wawayanda / Pochuck River Watershed



TMDL Summary

Phosphorus Loads for Black Creek Watershed/impaired segment

- Based on Land Use Coefficients:
 - **Annual Loading** = 2,856 kg/year
 - **Loading Capacity** = 1,795 kg/year
(TP not to exceed 0.1 mg/L)
- Load Reduction required:
 - Overall **TP Load reduction 37.1%** (including MOS)
 - the overall reduction is attained with a 50% reduction to the adjustable loads


TMDL Summary, Continued

Phosphorus Loads for Wawayanda/Pochuck Watershed/impaired segment

- Based on Land Use Coefficients:
 - **Annual Loading** = 13,545 kg/year
 - **Loading Capacity** = 5,170 kg/year
(TP not to exceed 0.1 mg/L)
- Load Reduction required:
 - Overall **TP Load reduction 38.2%** (including MOS)
 - the overall reduction is attained with a 73% reduction to the adjustable loads



TMDL Implementation (Point Sources)

- For TMDL purposes, point sources include discharges to surface water that are subject to regulation under the Clean Water Act, National Pollutant Discharge Elimination System.
 - Point source reductions are accomplished through NJPDES permits: effluent limits or Phase II stormwater basic requirements, as well as additional measures, if appropriate
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TMDL Implementation (Non-Point Sources)

- For TMDL purposes, nonpoint sources are those that are not subject to regulation under NPDES, including NJPDES Tier B municipal stormwater discharges
- Nonpoint source reductions are achieved through implementation of management measures that can reduce loads, e.g. land use BMPs, NJPDES basic requirements and additional measures applied to Tier B municipal stormwater dischargers, etc.

Resources for Implementation

- Agricultural BMPs: EQIP, CRP, CREP
- 319(h) grants for nonpoint source projects
- Environmental Infrastructure Financing Program loans
- Estuary Programs
- Private grant programs



Information



- All TMDL documents are available for download at www.state.nj.us/dep/watershedmgt/tmdl.htm
- Comments are due within 15 days from the date of the public hearing (COB on August 19)
- Submit written comments to:

Barbara Hirst, Bureau Chief
NJDEP – DWM
PO Box 418
Trenton, NJ 08625